Notebook Series -- Notebooks by Edison
Notebook, N-19-05-28

This notebook was used by Edison during the period May-June 1919. The entries pertain to electroplating, electrolytic cleaning, and dip cleaning experiments performed as part of his efforts to improve the commercial manufacturing processes involved in making disc records—efforts that included attempts to reuse master matrices for making more generations of molds from one recording. Some of these experiments involved depositing films onto copper record molds; others involved stripping those films and cleaning the molds. Among the deposits tried and found promising were compounds of selenium, arsenic, antimony, and sulphur. Additional experiments relate to the copper and nickel plating of the molds. One entry indicates that Edison arrived at and named a standard "8/4" selenium solution for cleaning record molds, consisting of 400cc of a 5 percent selenious acid in 8 gallons of distilled water. Edison noted that the "only item interesting to science in these expts" was the fact that "electro deposited selenium is a fairly good conductor." Another notation indicates that Edison "Wkd all Day Decoration day." The electroplating experiments are continued in N-19-06-18. The front cover is labeled "General Experiments No 1 Started May 28 1919." The pages are unnumbered. Approximately 110 pages have been used.

Disc May 28 1919

Experiments coating copper record moulds with a very thin film to form a new matrix which can be stripped therefrom easily, permitting many other matrixes to be deposited on a stripped therefrom without injury to the Master matrix,

Also to clean the master matrix Electrically

If the Master matrix is made the Cathode in NaOH, 20% Sol. and a very strong current used, the oxide if any on matrix is reduced to metal dirt particles are forcably removed by the great outburst of hydrogen gas, and the grease is thrown off if inorganic + thrown off + decomposed if organic, This cleans the surface nearly perfectly even with an old discard working mould and the special film is plated on the surface evenly. sometimes the

old mould is very dirty and after this treatment shows spots where the film goes on too slowly. in this case — if after gassing as cathode in NaOH 20% it is washed well + made anode in regular Copper plating solution using a moderate current density for a few seconds, it makes the surface absolutely clean + when washed + put into the film plating solution the surface is evenly deposited upon

I will determine the strengths of Electrolytes and Current density for our 10 inch matrix, all thru the process

So far results show that apparently that Sodium Selenite Electrolyte deposits a tenacious film upon Copper when it is cathode in solution of the Sodium Selenite,

Apparently the selenium is deposited & part combines to form Copper Selenide & part as selenium.

If the film of selenium is made cathode in 20% NaOH, it dissolves off slowly whereas under same conditions Arsenic film comes off quickly & entirely, apparently showing no combination of the Arsenic with the Copper

Selenium film after washing & drying cannot be removed by rubbing, even with Tissue paper, no matter how hard or long it is rubbed.

Also the Selenium film receives an very fine glass polishing polish without apparent injury

In the case of Arsenic film after removing Electrode from the depositing solution the tissue paper is slightly darkened by some black

flocculent arsenic coming off -

This is not true of Selenium - however the arsenic film receives a good polish but not so bright as Selenium,

After polishing Arsenic + Selenium films the Copper is deposited on both easily + evenly -

The Copper strips very much more easily from Selenium than from Arsenic

The face of the Copper stripped from Selenium if latter is well polished is bright + clean + shows no smut of Selenium whereas if deposited on Arsenic the Copper shows a tint due to some arsenic coming off -

However it is probable that if

the arsenic is buffed & highly polished none will come off.

Probably Selenium being softer than Arsenic gets a smoother surface & more polish than arsenic hence Copper does not carry any when removed,

This would necessitate that to prevent Copper removing any of film matter that the film or matrix whatever its nature should be highly polished preferably by a fuzzy buff that will polish bottom of grooves as well as tops of sound waves.

In using Arsenic a rough expmt with Copper strip 1" wide & 2½" long in Electrolyte that 20 milamp for 10 to 15 minutes deposits good Arsenic film, even ok if Copper is well cleaned by Cathoding powerful Current & subsequent slight action to anode,

with 3% solution or 15% solution of Arsenite of Soda the arsenic film with 120 milamp 10 @ 15 mm is equally as good showing great range, I should say 15% sol is OK — as Ar is removed it will last longer

In making Arsenite Soda solution there is a flocculent substance in solution of Selenium. This does not filter out but using bone black the solution filters perfectly clear

The Selenium solution filters clear without bone black - solution keeps clear when exposed to air

This appears true of Arsenite of Na -

Both sols are alkaline & probably absorb CO_2 must determine this,

I also tried Antimonite of ~~Potash~~ NaOH (see which) This forms a metallic Zinc like film & acts well, Copper strips from it –

Must experiment further with this –

Also tried Tellurite of soda. This only deposits cloth on Copper. = Solution darkens in the air perhaps solution not properly made,

Sulphite Na Hyposulfite Na Sulphide Na dont work on Cathode but does at anode this is true also with Iodide K Bromide K & Chl K
Anodic deposits poor & not promising, comes off when made Cathode in plating Copper

The 3 promising are

1st Selenium
2 Arsenic
3 Antimony

Note,

The only item interesting to science in these Experiments so far is that Electrodeposited Selenium is a fairly good Conductor, it is not probably deposited directly as a metal but is result of a secondary action of Sodium reduction -

It will be valuable for "light" changes of selenium Expts.

I note that voltage ~~with~~ is high with 4% Arsenite, 2 Volts gives with $2\frac{1}{2}$ face 1 side 14 Milamp.

Further Experts Arsenite Na 4%
on 40 minutes, started 14 milamp 2
SB Cells, at End 40 minutes it was 18
Milamp — The deposit is rather
bright and shiny - seems ok - but
under microscope

Note very fine balls or crystals showing
deposit entirely to thick —

Probably 10 @ 12 minutes is all
that is necessary but its
interesting to know that smooth fine
deposit can be got relatively thick

Saved it Marked #1

I have just stripped the Copper
plating from an Electrode covered
with Arsenite of slight thickness +
polished + find that the Copper
only removes a faint amount of
Arsenic, Copper is regular Copper color
but from looks of Arsenic covered
Cathode it would have to go into

The Arsenic film set for a slight additional coat to 62 sure —

It is likely that anoding the record is bad as it produces a matte surface & tends to matte the arsenic film & this in its turn mattes the deposited Copper interfering & pulling off some arsenic —

Must find a way to clean surfaces without anoding — The Soda Solution is probably OK for new Masters but not enough for old working moulds as we will only use new moulds its likely the Soda cleaning will answer

~~Either~~

This strip from which I stripped Copper from & which showed a Coppery shade in place but back in bath 20 milamp 3 minutes Copper disappeared

But I noticed finger marks which this plating brought out Conspicuously

NoTe →

In handling filmed moulds & stripping matrix therefrom they will be spoiled if finger marks get on

Filmed Moulds cannot be Cleaned in Soda as the film is quickly removed by current, both with Arsenic & Selenium,

Its difficult to reason out a process whereby the can be cleaned

Took fresh old wax mould record strip, cleaned it Electrolytically in Soda & put it in 4% Na Arsenite - Mil amp 14 current

(91)

immediately down to 11 Milamps x
in 2 minutes went up to 16
Milamp — + is partly coated x
4 minutes 18 Milamp — I note
green streaks on it — probably
I didnt clean it well — x
2 minutes streaks gone — good
Coating on + Even + Ok for
Regroark —

I will now leave it in bath
plating at 18 Milamp +
go to supper - 7 pm — x
returning at 8 15 pm current has
increased to 21 Milamp x — Deposit
at 930 Ma gone down to 11 — Removed it x

look good & bright to naked eye

Notice that arsenic film thin, rubs off easily with pencil eraser & thumb. The arsenic does not combine with the copper to form an arsenide, simply plated on

Selenium - Note copper when pulled off does not take any of the selenium film that copper is bright. The selenium was rubbed with toilet paper to brighten it before plating —

Eraser of pencil removes film with more difficulty than arsenic -

Note

Selenium strips very much easier than arsenic —

Even the plating on the back stripped easily & OK where selenium was exceedingly thin,

Think films should be very thin either with arsenic or selenium, just so face is unmistakably covered, & after designing buffed very slightly to polish —

Just rigged up Copper plating bath so can plate several strips at once. Carbon Res + ammeter

I find 3 X 1½ strip that takes immersed to 3" amperes burns + makes red deposit,

The strip I had in Arsenite Soda 4% for 2½ hours is OK - had very good matte surface, not perfect in grooves but Music Wires not ok

I rubbed it rather violently with bunch of paper, - I noticed one small area of Copper appeared in the 2½ inches under micro. This shows film chipped off - film is brittle - deposit appears to be .0005 thick I put it in big Copper bath ½ amp to start with -

Everything goes to show should have their films, dried + buffed by a very fine cotton or hair brushed to polish -

Note

Arsenite Na – Depositing film on Nickel instead of Copper

on 9.40 12 MA – took out

10.05 25 min – Nickel looks darker, covered OK but Arsenic is dull + resembles Ni so the film is not so striking contrast as with Copper –
Put in bath

Phenomenon – The above Nickel had been used as an anode in the Arsenite Solution –

I took another Nickel + Cleaned it in Soda Cathode –

On putting this in 4% arsenite bath it coated much darker in 2 minutes than the anode Ni did in

note

25 Minutes —

It seems that while Nickel as an anode in Arsenite Soda. Selenite Soda Elc in alkaline Sols & appears unchanged & bright there is some very adhesive film on it which prevents goods deposits by plating being formed on it whereas if subjected to powerful Cathodic acid & Soda 20% This film is removed & deposit goes on at once & even

Selenite Na Solution % unknown is very much better conductor when 4% Arsenite gives 11 mil amp — Selenite throws Meter off scale —

Selenium I find with 20 Milamp unlike Arsenic is entirely too high surface density of current it actually deposits & flakes up & throws off -

About 10 ma for strip 1" wide - 2 3/4 long - facing the anode & of course the back which gets some then it deposits in 3 minutes a bluish even film - This is about 3 Milamp per inch 2 is safe.

or 80 Milamp for Reg desc

1/2 immersed,
in 2 min more instead of
bluish is deep pink,
2 minutes more pure blue
+ very even -

Phenomenon —
Arsenic covered plated
bug bath 1/2 amp density
on stripping <u>all</u> the
arsenic came off on
plated strip.

It was probably the
thick 2½ hour deposit
that came off ~
later No not so,

Queery
If density of Copper plating
Current is high will not the
Copper be driven into arsenic
~~where~~ + Cause arsenic to
Cling to plated strip
Whereas if first coat of
Copper is put on a low
density, + after Coating)
The density is increased
will it then not pull off
the arsenic
Test,

Note, Cathodes made from
Comel Copper sheet full
checks + surfaces are not
cleaned by Cathoding in

[41]

Soda except for greasy,
Spots do not cover
Electrolytic Copper and
discs strips act entirely
different,
On Comal Copper.
Can only use 5 mil amp
to deposit Selenium
which goes on fairly Even.
This shows safety lies
in very low current density
in deposited any kind
of film - 1 milamp per

inch is probably OK —
or 40 Milamp for 1/2 immersed
disc —
Even if 3 Milamp can be
used on Electrolytic a only
1 on Cond its safer to use
One Mil amp on Electrolytic

May 29 1919

I find by dissolving a little sulphur in hot 20% NaOH, & diluting to a very light yellow tint. The Cathode strip dipped in it in a strong current that Copper Sulfide is formed of any required thickness from a faint shade to deep blue & that a light shade put in Big bath & plated on strips from Both plated & original are dark, very [illegible] the film.

still left on dipped Copper is perfect. The pulled off strip film is also perfect.

Think several strippings can be made before necessary to dip in solution again.

This is the most practical of all as its not a film which may pull off but an actual combination of sulphur from the water partly transferred to plating it makes perfect stripping

I note that if the film is subjected in 20% NaOH to powerful glare for 10 min it does not decompose the sulphurized Copper it lightens the shade only but is stick perfect

Note —

I tried dipping in Bromine water but the film of Subbromide is not sufficiently Colored to tell, it shows a duller shade —

Iodine in alcohol poured into water & Copper dipped shows better than Bromine but not enough for practical work I think —

Sulphur appears to be the most practical film ——

Selenium dissolved hot in NaOH 20% when poured into water decomposes to a flocculent substance apparently copper in time a very light film deposited 2/2/1011,

So far Sulphur best, Especially as of all metals Copper has the greatest affinity for it, CuS is a conductor. also anhydrous + will not oxidize in air –

Note,

When a cathode strip is Cleaned by big Current in 20% NaOH washed & put in light yellow NaSulphur Solution it Coats slowly but when Cathode is stirred it Coats very rapidly –

It will probably be necessary to rotate disc in Very weak solution – otherwise owing to Extraction of S at Contact it can only get S by circulation & this may make deposit uneven

Rotation need not be used if yet of the solution agitated solution

I stirred the cathode for several minutes when it reached a deep blue. Continuing further reached a deep lead color & then it appeared as if it would go not further,

It covers in bath rather quickly but seems to be slower than with lighter films —

None of Sulphur films are attacked by regular plating solution with H_2SO_4 in —

This is fine —

A fresh cathode coated Sulphur put in NaOH 20% & big Current, it became darker & could then be wiped all off with towel

So these films cant be cleaned at first but after plating & stripping dont seem to be affected by cleaning in NaOH Current.

Just found that fresh filmed Copper put in NaOH 20% without any Current can be wiped off so the Soda has an action

I now find that S films after plating it put in NaOH + Current wipe off

So Alkali decomposes the Sulfide Copper + loosen it —

A film of nickel .002 thick deposited in 17 hours from an arsenited surface on old discard Copper matrix, using bag filters + 3 jets at low angle 72g plating sol NH4 Ni Sulfate was brightest of most we ever made in this lab. The record on plated side showed in Mecro that it was more shiny + cleaner than the original. We use Ni anode containing 8% Iron + the filtering was perfect keeping away the flocculent ferric hydroxide from being plated into the nickel, also the 3 jets helped

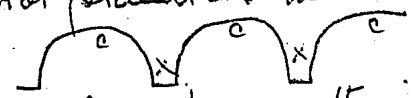
This Ni is brittle breaks bending once on itself — 4 times

in fact breaks before. — 3 times

But if hard on hot plate 250 Fahr for 1/2 hour it can be bent slightly more

(cont)

another thing I noticed that it was not plated as much



at X as at C hence thinner at X - hence tors along grooves when pulled off mixbix -

Also noticed that arsenic film had spots where film pulled off copper. This is very bad feature of plated films which do not combine with the copper. Sulphur being an actual combination is free of this defect,

Selenious acid

10 Ma deposits in 10 sec a black film —

Later = Deposits without current like NaS -

Arsenious acid is slightly acid —

The deposit is extraordinarily Even —

When Copper is dipped + Coated blue, washed + dried, it cannot be rubbed off by toilet paper So its as good a Sulphur in this respect, its appears to Cover more Even being an acid solution

(65)

The selenious acid dip film is not affected by your acid copper plating solution —

Also it receives the copper plating right away & OK in all other respects —

If rubbed immediately after dipping most or 1/2 comes off with toilet paper but none after drying —

Note If copper is not cleaned by current in NaOH film not even but if cleaned 10 seconds film perfectly even

Sulphur, with very light film shows no film after plating on silver, pulls off very hard — Too Hard for practice —

Dipped 5 min in weak NaS — light film shows dark on both. Comes off Easy & OK

Blue film — strips fairly Easy blue on both, most on Cathode OK —

A Deep blue Neg-film pulls off Copper

Remember these Cachets are Commercial Sheet Copper full Check & flaws —
Results be very much better on Plated Sheet Copper —

Evidently film should not be too thick or too thin, full lead is about right I think

I now put 4 Selenious acid dips, Light + heavy films in big bath for all night, Now 4 pm — Wife wants me to go in town —

They all cover quick
1 amp for the 4 — Each 3" front + 3" back —
Will leave at 1 amp for all

1st Strip

Copper cathode strips dipped in Selenious acid. no current, –

Color Very light red.

Strips perfecting no disturbance of Selenium on Copper

Copper stripped off bright without any apparent selenium on it

Commercial strip copper used it was cleaned by NaOH + Strong Current,

These 4 strips now described were dipped in Selenious acid, Washed well at faucet, then rinsed in distilled water + then hung up 3 ft above hot plate to dry for 1/2 hour.

2nd Strip was Lead colored (1e)
very thick Selenium - This had
only very thin plating none on
back + not all over on front
Copper stripped off bright +
free from Selenium,
Cathode selenium film intact
+ perfect,
Should say Selenium was so
thick + so poor a Conductor
that it didn't plate much
probably wants high Voltage
Test this!

3rd strip

Strip with deep blue stripped perfectly, heavy deposit twice as thick as strip with red color

No selenium came off of stripped copper, blue film intact -

The back is even more perfect in fact it is perfect. The copper stripped off is very shiny - with no trace of selenium. This had a very much lower current density - 1/4 amp was used -

We must use probably 10 to 20 milamp at first to get perfect covering & then increase amperes to desired amount

4th strip Lighter blue

On front where current density greatest, Copper stripped off far but bad spots.

On back where current density small, Copper stripped off is brilliant + film is unbroken.

Selenium is the easiest stripped in fact it is far superior to any others, there is not clinging at all when current density at start is low,

I shall adopt
Selenious acid dip
Washed by a forced stream rinsed with distilled water & dried — cover over with 3 mil amp per inch of face ignoring

the back in calculating —

I notice that strips from old working mould cleaned by Current & 20% NaOH, washed & put in Selenous acid gives a perfect blue selenium film absolutely EVEN

Blue film. Selenous acid dep — Copper Plating

2 cells —	10 ma.	7 mm	no deposit	
	20 "	25 "	"	
	40 "	16 "	just slight Cu	
	42 "	18 "	nearly all over	

Transferred to small bath after 1 hour stripped fine very thin sheet very bright film intact, Cond Cu — OK

3 Cells

Cathode from old coke mould
Blued in Salamons acid cooked
dried over hot plate

10 Mil amp	10 min	faint chro in one spot
40 –	12 "	shows a little more
80	22 "	scant covering
80 Ma 3 Cells	12	a little more
80 Ma 2 Cells	1 hour to deposit	

found it all covered over good

later — Red colored film –
200 Ma covers in 8 minutes all
over – after 3 hours stripped ok film uniform

Blue color

200 ma covers all over a OK
15 minutes – 3 hours stripped
OK – film uniform

I now make one goes considerable
beyond blue to lead + beyond that
to metallic looking –

One that went beyond blue
till metallic looking
Covered all over in 10 minutes
put in big bath 3 hours
stripped perfect + without
pull = just like lifting it
off. Noticed plastic tape
was fine & bright but had a
pink tint just barely perceptible

This is ideal if OK — go just
beyond the blue till blue
disappears,

But the Margin is very
great from ~~B~~ light red
to beyond the blue or in
a certain strength of selenious
acid (very weak) for 1 min up
to 5 @ 8 minutes Watching
it in solution during
immersion

Can strip off the Thermint
film .0002,

If you go further than just beyond blue stage,
It gets Brown + a flocculant lot of Brown is on surface + can't be washed off by powerful stream from faucet but can be wiped off - but in doing so a little of Copper is shown

This shows that overdoing it expands the selenide of Cu so much it cracks + then there is further penetration + finally all will come off in powder.

It seems the film will be firm up + just past the blue

Probably blue stage may be safest,

Wkd all day Decoration day — 2

film at 1500 Ma thick -

1/2 thick would be ok to strip

3 hours at 300 Ma will be ok for tests.

4th stripping ok but notice a hole where there was a round spot copper bright on Matrix, also 2 or 3 very small holes which were probably in Matrix — There are several other flaws. Think shall have to Either dip a little after Each plating or inspect + put a fine dot of Selenium on flaws — Probably some of flaws are due to dirt clinging in plating solution,

Saturday -

Last night put in a blue selenious acid Cathode of old working mould Record. Covered ok in 12 minutes with 200 Ma — left it all night from 6 20 pm till 10 30 am next day with 100 Ma on —

Stripped perfect, used asphalt paint around edges, no cohesion of plated Cu to film, latter intact + is now in for another plating, starting 250 Ma —

Nothing could be more satisfactory so far.

2nd Stripping 200 Ma amp 20 min Then 300 ma amp from 11 10 am till 310 pm Total 4 hours 20 min — Stripped perfect as 1st one no injury to film seems perfect, Into 3rd at 315 pm at 200 Ma amp for 20 min then at 300 for 4 hours off at — See left page

CAJ

What happened to

The Copper cathode I left in Selenious acid last night I found films split off & blue hydroxide precipitous all over, & bad mess, solution green —

This shows that the films reach a certain thickness Expand & Crack solution goes in attacks fresh Copper & so on

This shows film must not go beyond first blue allowance it may Expand Crack & make flaws —

Note

This supposed crystalized Cu hydrox - not attacked in 20% NaOH. Cold

in watch glass in 2 bulles decides gets darker in 20 minutes after pulling on

Stands 127 Fahr. Bluish

The copper left in Selenious acid 15 hours which gave off films & considerable granular blue pieces, I find that these blue pieces are beautiful Crystals glassy transparent, & form the principal bulk of the action

What are they ? ?

Crystalized Hydrox of Cu or Selenate Selenite of Cu or What ? ?

probably Cuprous selenite, most H_2O

I also find solution green & perfectly Exhausted as a fresh Copper is not acted on

Arsenious acid dissolved in boiling water & hot does not form a film except very faint even if waved a long time in the hot solution, or when sol is acidulated with H_2SO_4 — slight tint given only

In plating on blue selenious acid film with Cu I notice that it leaves the sound wave part very much easier than smooth part —

Tartar Emetic deposits some metallic (Sb) with Current but it dont measure it to a very poor deposit, It doesnt deposit by simple immersion —

Put in as selenium Page 12

The Question is now Shall we use Selenious acid dip to blue, & trust to get off 10 to 15 Matrix without chance to repair mandrel

in case specs flake off.

Or should we deposit a film from Sclenite Soda by Current, which tends to pull off Each time its used by when it gets bad can be cleaned of the film by making it Cathode in 20% Soda + use of powerful Current + then replating a fresh film saving the master — Work

this up. trace of practicable.
+ better than immersion.
Dipping allows reaction
by forming CuSelenide. -
Whereas plating SE dont
attack second,

Note, We must have at least 3 strong jets of solution against the Selenium face while covering to keep dust off -

Also I think that after 2 peelings we may have to make an extra Selenium dip to light red stage to cover any flaws.

Also if a flaw is seen where film is pulled off think it can be locally repaired by a minute drop on a needle like point, allowing it to act & then wash it away by distilled water,

At 10 40 am put in 2nd Cathode painted Edge Blued in Selenious acid washed distilled water previously cleaned in NaOH 20% heavy current

After washing well at faucet & then distilled water dried it over steam plate then painted at Edges with the Asphalt Varnish & dried 10 minutes

Put it in 150 Mil amp
300 Mil amp on at 1110 am -
Sunday -

Nickel

The Copper strip Selenous acid blue — put in Reg Nickel plating Solution Nickel strips but pulls off the selenium from the Copper it is all on the Nickel —

The Varnish is underneath + is probably changed by the Nickel Solution, although in Copper solution it is off —

Notwithstanding low current 150 ma plating Low amps End not good think 100 ma or less is necessary for Nickel —

I am right wants low ma got 20 ma on + covers ok now + then a bubble on Ni shakes free wants circulation —
Think film will not pull off if started + covered very small Current. The Varnish wont do for Nickel Solution

By leaving Nickel Cathode in Selenous acid 3 or 4 hours at blues. Plated Copper over it + stripped it — it stripped hard + ½ of Selenium film stand on Ni + ½ came off with the Copper

I painted a strip all over dried + when put in Copper Sol adjusted to give 300 ma it gave 100 milliamp —

The Edge is bad — where Var red it break from + deposit in pieces —

Took a Comal copper having rather smooth Edges varnished dried + re varnished + dried —

no Se on —

Note I put some selenious acid in our Nickel plating solution
No action on sol-

Yet dipping Copper in it it blued OK

Also put some selenious acid in our plating sol
no action on solution
it dont blue it but
Browns it & some rubs off
leaving a dark-red.

Start Experiments on various Varnishes for Ni plating, different solvents,
Start & plate at 20 ma.
& see if can increase to 50 @ 75
or 100 ma.

Try nitrocellulose
Cumerone resin in various solvents
Linseed oil
Rosin Varnish
Jutalong
Marine glue
Paints from G W Estln Elec
Burnt rubber

Note, When Ni is plating with asphalt bonder Varnish Even with 20 Mil a + Covered the Varnish is all full of bubbles, along Edges & generally all over. This is not true of Copper plating —

No 5 A. was dipped in selenious acid giving very slight red, then No 5 plated this dont show any of the defects on No 4 —

Showing that if we first dip to full red + then take 2 Coppers off — then a very slight red dip gives 2 more + so on think can get 10 to 15 without the several dips being heard as altogether it will not be as much as beyond blue which gave a good strip —

Low density of Covering I think is good —

50 @ 100 Mil amp for both sides when Covered thoroughly Can go to 300 —

Ni 20 then go to 75 possibly 100 must have circulation

Nickel -

The blued Copper put in Solution of Reg Ni Sol at 4 55 Sunday pm at 20 Ma I find at 9 am monday was 10 Ma. + good nickel plating Came off about same as Copper plating - Condition perfect.

1/2 apparently Came off on Nickel or perhaps more as Ni strip was darker than Copper which was reduced from blue to Light red - Apparently Ni has more affinity for Se than Cu yet this cant bring on deposing of the Ni metal ion in formed into the Se - in any Event it wearies off Even the brass came off but it was very thin + black in middle -

Made a Dep of B. Called DX-
There were some bare places
pulled off - put in Se Sep 5 sec
& started depositing again
This had a varnished back but
it was only fair, Edges all Copper
it dont work on Edges Varnish
made great where high density

Possibly if had been less density
might be OK but doubtful
200 ma all night -
Think this Varn ng -

Put one in 455 Sunday PM -
out Monday 9 AM. 200 MA

This was coated light red

Came off perfect,

Put in again without
redep'g, for another Run

note

It looks as if red film stick better + will be safer than blue as it can be redeposed more often without giving sound at defects,

note

I find that if Ni Cathode is cleaned by sand paper & then by Current in NaOH 20% that it gets black in 2 or 3 min in very weak Sc acid about 4 to 6 times lower resistance than Copper —

June 2 1919

A

So far have stripped 8 films off a blue. Se redipped once 5 seconds after 3rd. 5 after dip, the 5 are OK

On another one B only se to red full length mostly grooved of record got 4 off + all apparently perfect Cathode looks perfect,

Dark red or even light red is I think even better than blue as film is tougher + also it gives chance for 2 or 3 redips before wheat goes past blue stage

Put on this page by mistake

4th June –

To date dip in Selenious Acid to light red, deep red, red ~~+some~~ blue is OK possibly pure blue as if a spec comes off a 4 sec dip to get very light red on spot brings it OK again,

Have made 10 strippings with only one 4 sec dip + still OK good for twice or more with possibly a 4 sec dip –

With a Cathode not pointed at the Edge can with Conc Sulfate of Nickel go as high as 10 amp density rate on a 10" disc The Nickel is hard springy + Tougher than we have had –

BUT When I point the Edges it strips with 10 amp density but not at 1 amp density but may when it gets thicker (See 3 pages ahead)

June 2 1919

I made up some saturated Nickel Ammonium Sulphate Solution & found it covered OK with 200 Ma amp density standing still. Would stand 3 @ 400 Ma rotating & chunk

The solution used for Celluloid is much weaker & will not stand over 50 Ma. Mac says if he makes it stronger pulls off Celluloid –

Mac's Nickel is very hard & brittle breaks ——— breaks whereas with saturated sol my nickel strips called be bent & straightened without breaking – surface is matte & not bright like Mac's

Nickel clings far worse than Copper to the Se film & appears to be discolored

slightly red from the red film on the Copper Cathode ~~Then~~. The film on this Cu Cathod is light red & appears to be perfect after nickel removed, except one small spot I redipped till slightly blue & this spot turned red showing how the redip repairs defects or pull off of film on spot

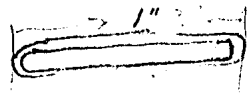
June 6 1919

Think that I shall have trouble in preventing Nickel from peeling from Selenium Without an

Anchoring at Edge

Experts show that without anchoring around the Edge the Cathode strips in Conc $NiSO_4$ + hydroxide only 100 mil amp can be used - Even this is not sure, in fact its not sure even below

But if anchored



2 inches long

A density of 200 Ma is ok 14½ hours deposited on front face 007 - stripped perfect back nearly smooth - showing allowing equivalent

Jan 6 1919

of 1 inch for back, making altogether 3" sqr - with density of 200 ma ~~sq~~ is OK & safe & good deposit, As the disc has 26 times the area, 5 amperes can be used & give 007 in 14½ hours 2·07 hours per 1/1000 thickness, if 005 is to be the thickness on disc then 10½ hours required or 2 matrix in 24 hours

I find the nickel tough

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not springy, if bent it stays bent, probably the 14 hours permitted the Na hydride to slowly decompose, or that owing to strong solution + low density very little H was formed to make hydride.

The only doubtful thing now is, will it crack when put on the 10 3/8 disc —

I took the Conc Nickel sulfate Solution with $Ni(OH)_2$ in that I have been using — added 33% of H_2SO_4 — + started at 100 ma for 20 minutes $2\frac{1}{2}$ hours 200 Mil amp on taking out found covered with Ferric also the deposit so brittle it had flaked off in spots & all was excessively brittle & ng —

Evidently iron in the Solution is fatal —

This shows filter press plates must be heavily

Nickel plated & no iron must be used around solution, also pure Cast Nickel anodes used, free of iron - Solution kept Continuously neutral by use of Nickel Hydroxide fresh & not dried, but free of Sulphate Soda or iron

Tests of Varnishes on Ouell Matrix strip - Cleaned Elec in NaOH, washed, Red in Sulphuric acid - Painted 2 Coats after thinning down, (Fredette)

#1 - Varnel Varnish used by Cabinet dept Silver Lake. Bad at Edges only 120 Ma 10 min in Acid Copper plating Sol. 3 calls +

#2. 110 @ 120 Ma - Japan baking Moller & Thumain - Bad Edges opens on flat part.

#3 Newark Varnish works Cabinet baking Var. 110 @ 130 Ma. Bad only on Edges

2 Coats

#13 — 100
160 —

Edge OK — all the Current
went from 3 fine bubbles in
Varnish —

This is a good Varnish
Its our Reg Condensate
without Lampblack

#12 B+P Bad Edges 120 ma
180

#11 Eccobatto. 120 ma
180
Bad Edges, some on flat

#9 — 130
180 Very bad Edges
flat pretty good

#10 60 —
120 — Bad Edge + flat
Asphalt Varnish

#4 Velvet finish Enamel, Kno Kay Enam
Co 110@120 Ma bad on Edges on flat.

#5 Armature Var 110@120 Ma
Bad Edges + middle.

#6 — #1378 1st Coat enamel K+S Co
Bad edges considerable on flat.

#7 Murphy baking Var 100 Ma
Edges good except at bottom on few
~~[illegible]~~ areas on flat,
Probably best of all, possibly too
thin.

#8 Lacquer from Rhono Lake
130 Ma. fair on Edge but bad on
flat, Too Thin —

200 cc water, 3 cc of a solution of Selenious acid which solution Contains 5 grms Selenium in 100 cc of water, - this is.

30 mlg to 100 cc

The reds the small strip in about $1\frac{1}{2}$ to 2 min 2nd strip $1\frac{1}{2}$ min 3rd & 4th.

Made 10 dips - strips $2\frac{1}{2}$ long 1" wide altogether 5 Sqr inches each Cathode - The last dip took $1\frac{1}{2}$ min to get same Color.

This makes 50 square inches that this solution has filmed,

I dipped 15 strips last 2 required 2 minutes,

This is 75 sq inches in fact 80"

which is about surface of 1 10" $\frac{1}{8}$ working mould disc—

This degree of solution is I think OK—

Each 200 cc water having 3cc of a 5% Se solution is good for one dip—

or 5 discs to a litre

about 15 Discs to gallon

Big glass jar 8 gals

This will be OK for 100

June 9th 1919

deps, 4" from Top –

8 gals requires
450 cc of a 5% Sol of
Selenious acid —

Good for 100 Deps of
full sized Matrix —
Average time 1½ min
When moved Continually
in the liquid & 2 min
towards the end —
Developed on verge of
blue

After having covered 15 strips by waving in the sol of 3 cc of 5% sol of Silver nitrate in 200 cc water I found 4 strips in not stirred head got metallic like — I then put in 5 more strips without stirring — in 24 minutes all deep red —
Altogether 24 strips have been covered OK — or 120 sqr inches with the 3 cc

I then took 1 more & waving it it gave right shade in 8 minutes —
Might say that 25 Cathodes exhausted the solution 125 sqr inches

Standard June 10 1919

5% Selenous acid in H_2O
is to be called H/B

8 gallons distilled water,
400 cc of Selenious acid
well stirred – Requires
about 2 minutes if
properly cleaned by
Electrolysis in 20%
NaOH, to give full
Red –

For cleaning Mirror, etc –
20% NaOH.
100 amp per disc – about
20 seconds –

Can't say just yet if this is
OK

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Note: June 11 1919

One of Dally discs
OK – Clay flock + 50 50
Linseed Resin Oxidized
30 mesh –

Soaked in Water 15
days – absolutely not
affected at all –

In using 20% NaOH for cleaning a Electric C.
there is always a black deposit on the Copper —
If the sal is in hand rubber sulphur comes out & this helps to increase the deposit
After Considerable Expert have found that nearly a saturated solution of Sulphate of Soda made slightly alkaline with few drops of NaOH, does not give any deposit,
Also I have found that to get real good cleaning

the article being made
Cathode must when strip
is 1" wide & 2½ long
must have 4 SBat Cells
on format lear than
5 minutes a little
longer is preferable'
There is in circuit with
the 4 Cells the small 1½
Carbon-thoretal screwed up
tight, Think shall want
75 amp on ½ immersed
disc — for 5 @ 7 min
when daily —

I have also found

that there are dirt particles still sticking to the article after cleaning & of strip is washed with strong stream these particles do not come off. if the strip is put in Selenium and "a film" & washed with fly cloth wiped the cloth has dark smut, but after cleaning if while water is running over strip a brush is used these dark dirt particle

are removed, before going to the Selenious acid bath its better to clean for a moment in Sulfate Soda bath, wash, & put in Selenious — after film is on a cloth wipe does not wipe anything off — no amount —

I am using the old Tar bound battery carbon for anode in the cleaning solution I had to abandon nickel

anode as $Ni(OH)_2$ was produced,-

But the Carbon is slightly attacked, and Calomel deposits a little

I am trying graphite anode -

This cleans the Copper so Aluminum film is even all over which up to present has not been so, there being spots when 20% NaOH alone used,

I have made a Copper Cathode, filmed red with aluminum & have already stripped 4 good Ni strips from it without redopping its still OK –

Tried Acheson graphite Anode in Na_2SO_4 slightly alkaline – 25 mins full Current no darkening its OK for Concl work

[165]

June 15 1919

It appears that with dark red Copper coated film of Selenium that 4 strippings is about the limit when Nickel is plated on + that it should be redipped to dark red again.

A 2 second dip in cleaning solution Na_2SO_4 nearly saturated + slightly alkaline cleans off grease + does not

injures the film –

I notice that if nickel is taken out of bath & washed & then put back again & more plated on that the 2nd layer is not integral but seperates from 1st layer but not Easy.

After filming with Selenium & washing. The matrix should be immediately put in plating bath & not allowed to dry & the fingers under no circumstances allowed to touch the wet face —

June 15 1919 —

If a Copper is cleaned 10 min in Na_2SO_4 (alkaline slightly) sol by heavy current, washed & while wet squeezed between fingers, on putting in Copper plating sol the finger marks is not covered at once, takes considerable time to cover.

If I clean the Cathode strip wash & then film dark red wash & put in cleaning solution for a second, the finger marks go & on plating there is no evidence of marks. If filmed Cathode

is left too long in Na_2SO_4 sol with current on to long say 5 seconds it removes some of the selenium -

Possibly for this should have very much weaker current.

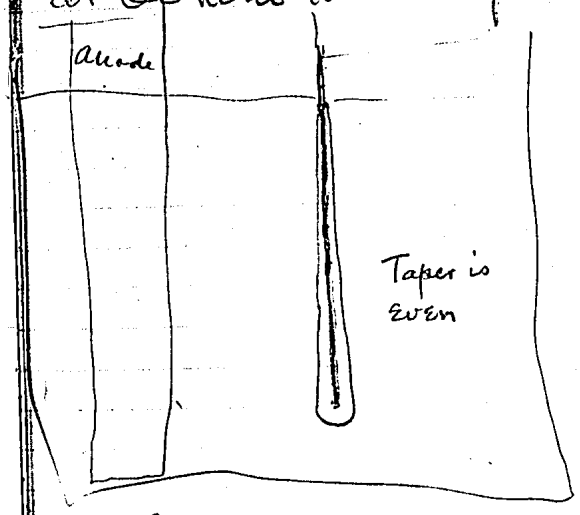
This cleaning if necessary which (I think it isn't) should be a second or sub-cleaning solution as cleaning films of done in copper cleaning Na_2SO_4 bath would liable to foul the solution with selenium

Note, Even pressing a clean cloth on film of Se while wet, This dont plate Cu over nearly as quick as where untouched shows Even cloth leaves something on but its OK as compared to a finger mark

Pressing clean cloth on a dry Se filmed cathode apparently does nothing

I used cleaned towel possibly washing soda in water & wet towel then wash it out & acid on film

Note All cathode strips plate in Copper & also nickel thicker at bottom than top



Why should it do this — What is the explanation

In any event the density must be about twice on last 1/2" as on 1st 1/2" hence by Centralization can double the density probably 2.6 amps on the 1/2 desc or 3 —

(115)

Dried all night blued Cathodes
dont cover so quickly as fresh
ones put in that. Probably
15 hours old & during the O2 changes
to poor conductor at 1st its
Conductivity & on drying
gets less & less & might ultimately
go to a non conductor at
covers 3 times slower than
fresh ones -

I note that if a dried blued
Cathode 15 hours old is
put in cleaning acid for 1
second the blue disappears
& only red remains but
this hangs on for many
seconds =

In tumbler with graphite anode & Na_2SO_4 sol. slightly alkaline, after working 10 strips 5 to 8 mins each 5" surface each that the sol has a slight yellow tint & there is about one gram of graphite come off —

I think the graphite has not been subjected to hydraulic pressure

We should have an anode 2 to 4 times larger surface than cathode to reduce deposit density also a filter between the cathode & anode I think linen will be ok as it very weakly alkaline

An old 15 hour blue filmed cathode, placed in trough with water over it & rubbed strongly with the coarse fibre brush doesn't apparently remove any of the O_2 film & it covers ok —

Rolled Nickel when cleaned well in K_2SO_4 & current

Selenium cell turns it yellow quickly - not so fast as Cu but it peels off Electro Ni - & it covers with Copper quickly

After stripping Ni 5 times from Copper Se film - the 5th stripping came very hard Then dipped it again slightly - The 6th Ni from this came off fine, easy showing - that perhaps to be perfectly safe

The Copper when Nickel is to be stripped therefrom should only have 3 nickels stripped off When it should be redipped, just ~~[illegible]~~ red, & it will probably give 3 more & so on

Note June 16 1919

Selenious Acid when put in Concentrated Sulfate of Nickel does not form a precipitate and films form on both Nickel & Copper takes over 1 hour when Ni is still in a sol quite strong of Selenious acid in Cond $NiSO_4$ to deposit a slight brown film

Therefore if nickel is plated in $NiSO_4$ sol say for 1 minute & held at 60° for 1/2 minute there will probably be a sufficient film of Selenium formed on the plated Ni to prevent the next plated layer from sticking — Therefore flake.

June 16 1919

Concl. heat Ni — film (with Se) after cleaning in Na_2SO_4 + Cyanide (alkaline)

Deposits Copper OK strips OK Color of Copper like Ni after stripping. This works OK but think Ni must be again dipped in Selenious & then another strip of Cu is to be stripped as Cu seems to take away the Se from Ni —

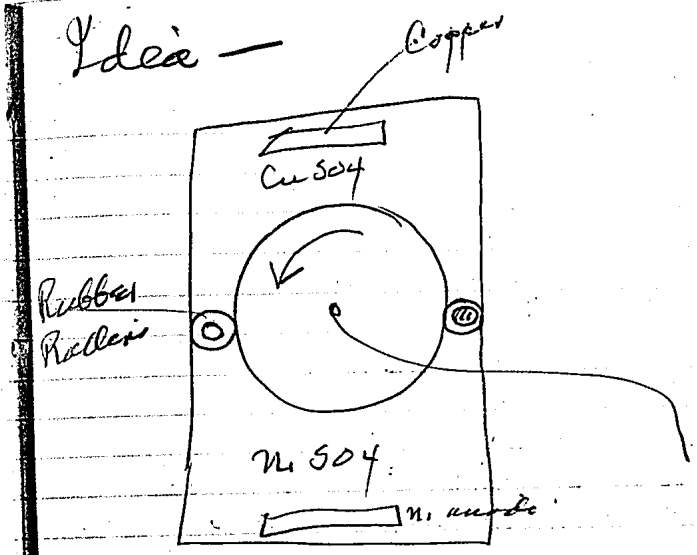
Conc Sulphate Magnesium made alkaline & filtered is not near as good a Conductor as Na_2SO_4 + it dont clean well — Another thing is that it takes a long time for the Selenious acid to give a film — ??

Note, Manganese sulfate mixes with $NiSO_4$ OK —

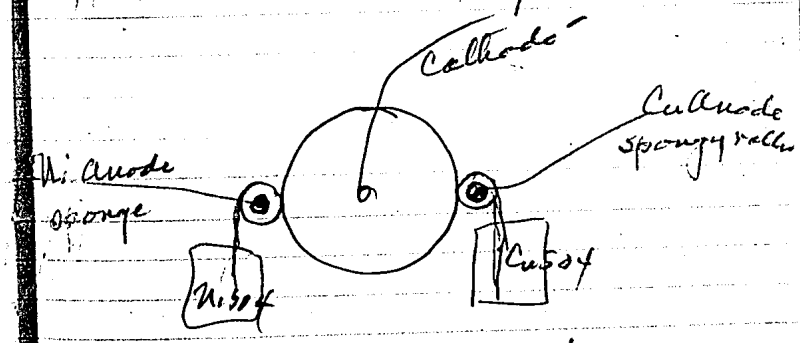
By using Ni anodes & Cathodes black peroxMn goes on anode & nickel on Cathode on Reverse Ni deposits on peroxide Mn & the previously deposited peroxMn is covered with nickel but after 2 Coverings it goes blow — & my think I have too much Manganese sulfate

When I put in $Ni(OH)_2$ it dont dissolve may be some action —

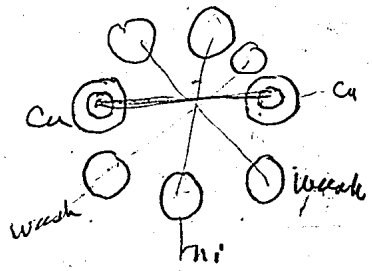
Idea —



Impracticable I guess



Might be more practicable.



Rotate instead of a Crane

June 17 1919

I coated Cu with nickel only 1/5 the usual amount then deposited copper on it & when thick enough filed edges & tried to strip it didnt strip as the nickel split itself a very thin film Ni sticking to Se Cathode & other part Ni sticking to peeled off Copper —

This Ni originally plated was at times taken out of bath in some changes

Phenomenon — If Ni + plated & then taken out of bath & exposed to air & then put back & more Ni plated these 2 layers do not adhere except mechanically by warts —

Therefore while plating Ni its Continuous plating must not be interrupted (1e) the Current must not be broken & it must not be removed from the bath, or removed & washed in water, as the two layers will not ahead & when stripping the first Ni layer well stay on the Selenium face & the 2 nickel layers will separate

I will not determine the exact phenomenon so as to know what to avoid

No 1 Cathode 100 ma Cu-filmed rod in Selenious acid (previously cleaned by Na_2SO_4 graphite elec slightly alkaline — then in Conc $NiSO_4$ + free $Ni(OH)_2$

100 ma - 10 am - out 1020 am washed + quickly put in Reg Copper plating solution

This stripped perfect.

No 2 treated as No 1
in Nickel sol at 10 26 am
at 11 am 100 ma opened the current
till 1125 then closed
it and plated more Ni
at 12 noon washed & put
in Copper sol

This stripped perfectly
leaving cathode with
nice light Se film on
both sides stripped OK

Note =

Potassium Cyanide
strong reducer of Selenium
yellow metallic —

see how weak it will do it

tried — Even a very weak
solution will remove it
in a few seconds —

Get time of removal of
a 1% solution —

Note. Copper put in KOH or
NaOH, turns black above
liquid & red below & is
attacked & dissolves —

If put in alkali in closed
bottle & no air gets
not attacked in slightest

No 3 in treated same as #1.
in 100 ma nickel bath at 1205 pm
out & washed well at hydrant
then distilled water & put
back again plating nickel
at 1235 pm — second coat
nickel on at 1255, washed
put in Copper solution

This stripped perfect

C(97)

No 4 treated same as # 1
Nickel plated in at 1.54 pm —
100 ma out 2.27. washed
& hung up to dry while wet.

hung up at 2 27 dry

2.35 — then put back in
Nickel bath 100 ma —
till 3 pm then put in
Copper bath —

Then stripped off bath
sides perfect leaving
light Sz film

Continued Book
2 Final Exports